First NASA/NCI Workshop

Sensors for Bio-Molecular Signatures

D060299a JPL PhotoLab

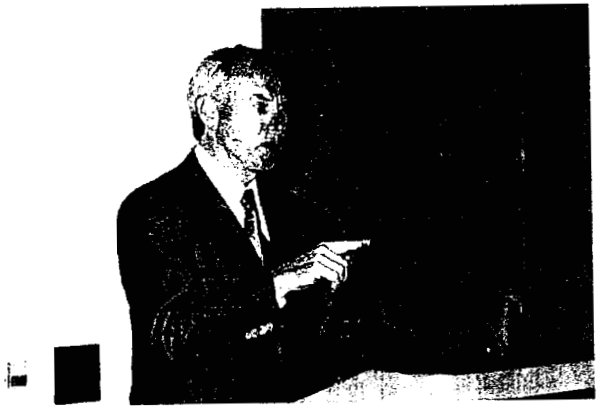
Workshop Sessions:

- Recognition of Bio-Molecular Signatures
- Micro/Nano Systems for Sensing
- Molecular Imaging
- Signal Amplification
- Information and Data Processing
  - Bio-informatics

Workshop Results:

- 150 attendees from all around the nation.
- Enthusiasm for NASA/NCI partnership on joint technology development and systems engineering.
- Follow-on workshop next year.

Biologically Inspired Systems



Vision

"Look to biology for true intelligence"

"Smart biological sensors"

"Self-repair, self-healing intelligent systems"

"... cells are the future micro-devices"

Mr. Dan Goldin, First NASA/NCI Workshop
on Bio Molecular Signatures, June 2-4 1999.

Goals

Develop merging of hardware and software technologies

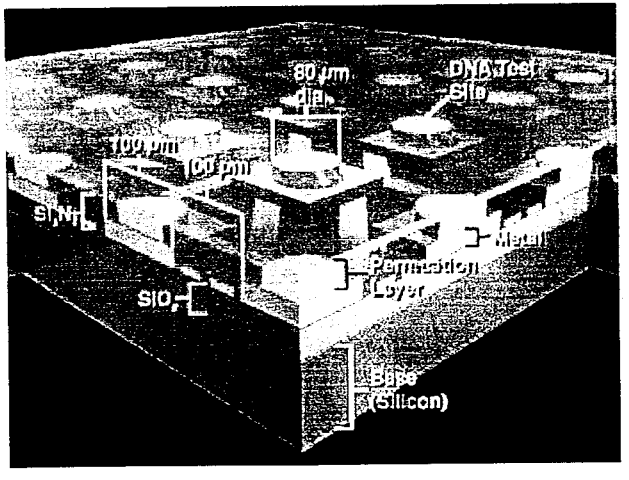
Develop nano-scale sensors with sensitivities at the molecular level

Biologically-based or biologically inspired evolvable systems

Bio-chips that combine the best of semiconductor and bio technology

Common Vision for the Future

- In the New Millennium the confluence of scientific discoveries in:
  - Biology
  - Chemistry
  - Physics
  - Computer Science
  - Systems Engineering

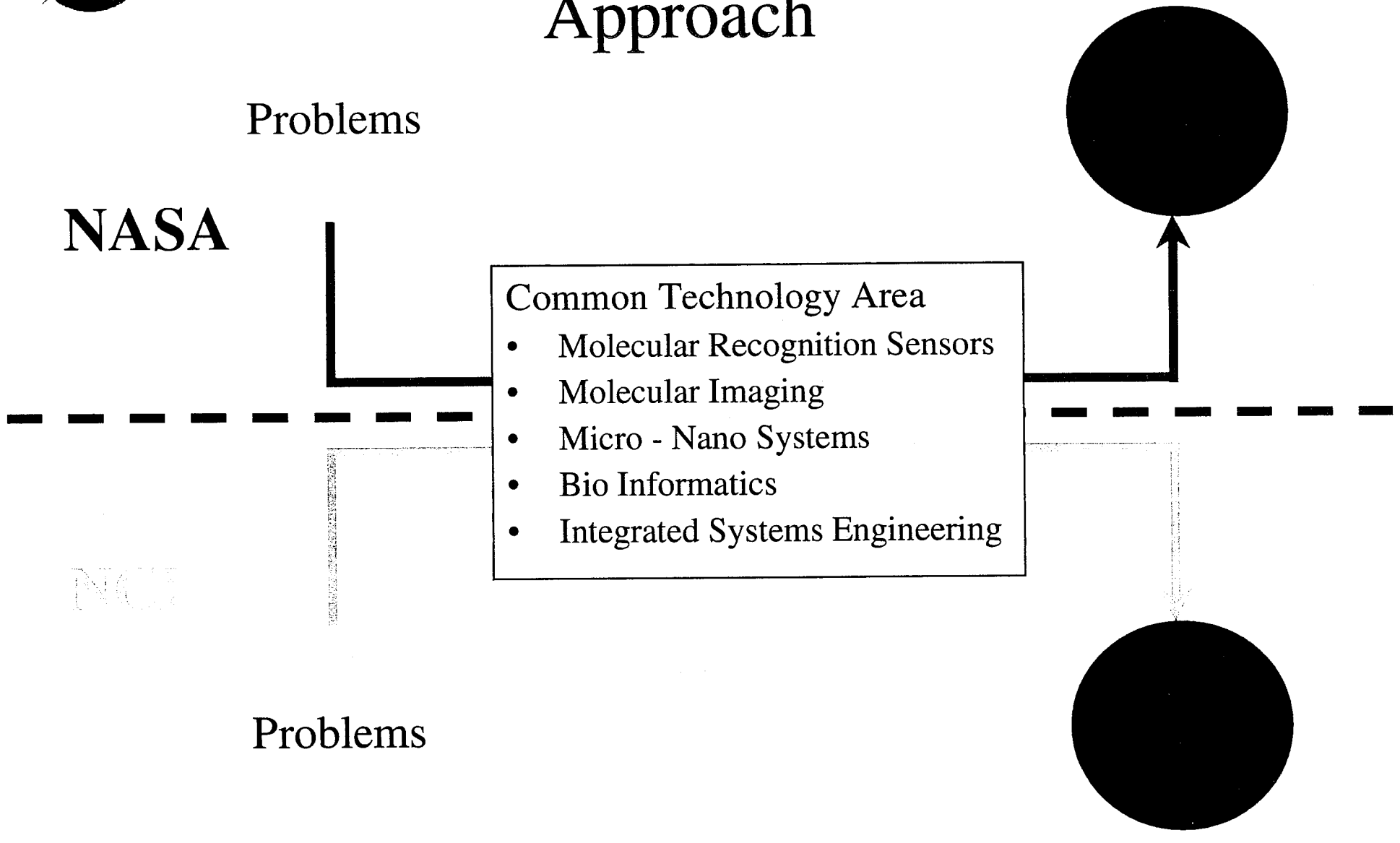


Source Nanogen

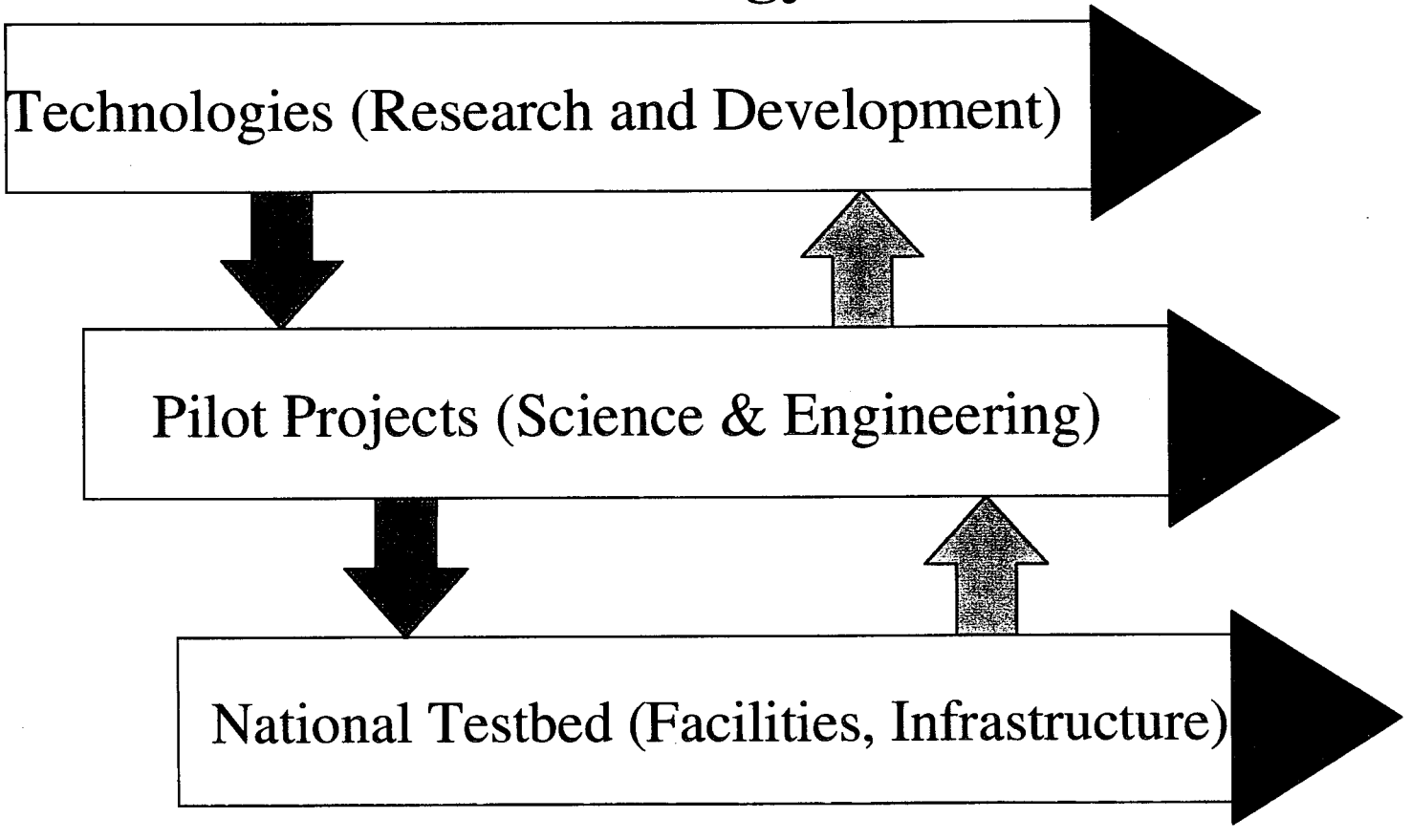
will result in a wealth of technological breakthroughs that will dramatically change/improve society and enable:

- … revolutionary systems for space exploration, science and engineering.
- … revolutionary approaches to the detection, diagnosis and management of cancer.

Common Technology Development Approach



Joint Program Elements



Molecular Recognition Sensors

NASA

Evolvable, flexible spacecraft systems

Biogenic molecule detection for the search for life beyond Earth

Bio-Astronautics: Human health, capability & environmental monitoring

Clinical diagnostics

Comprehensive molecular analysis

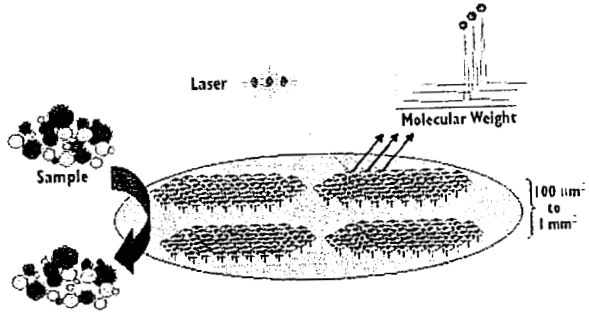
Cell & molecular biology research

Protein purification & characterization

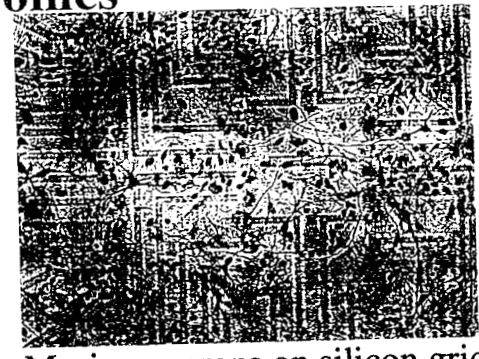
Intervention discovery and delivery

NCI

Bio-electronics



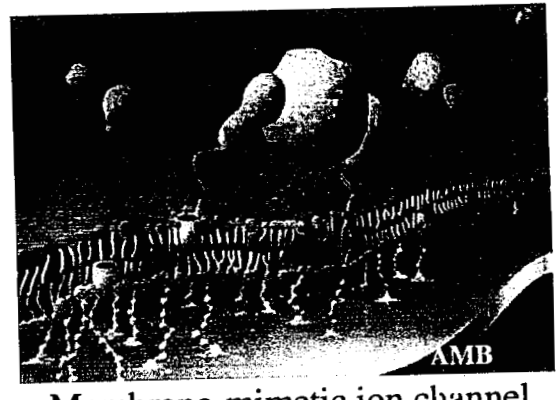
Silicon-based immunological probes



University of Texas image

Murine neurons on silicon grid

Biomimetics



Membrane-mimetic ion channel sensors

Bio-Modification

Henry Sun, JPL

Pseudo scytonema

Molecular Imaging

NASA

Fossil microstructures-imaging & composition

Ices—grains & chemistry

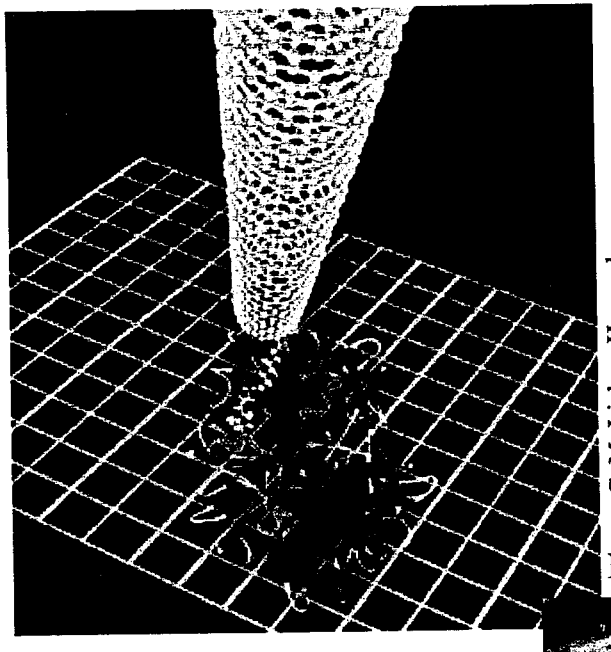
Minerals—chemistry & spatial heterogeneity

Molecular recognition

Genetics

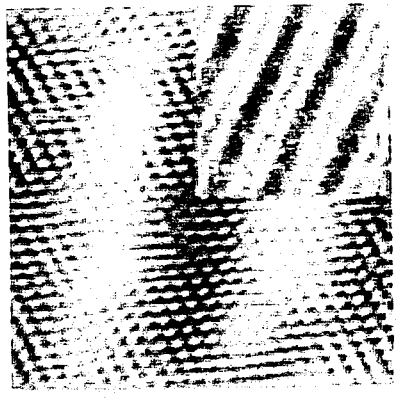
Drug discovery

Carbon-nanotube-based chemical force microscopy



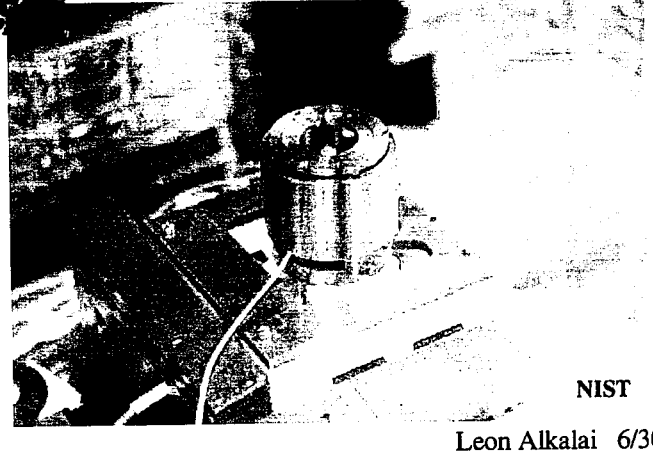
C. M. Lieber, Harvard

Au (111) surface



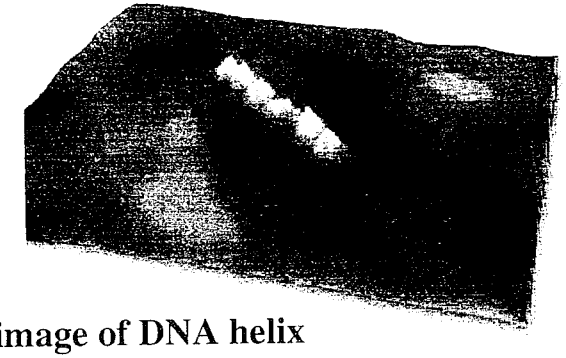
D. Lampner, Arizona State U.

Near-field scanning optical microscope



NIST

NCI



STM image of DNA helix

Micro/Nano Integrated Systems

NASA

Biogenic molecule detection for the search for life beyond Earth

Remote resource-efficient systems

Miniaturized biosensor "chips"

Array biosensors for multi analytes

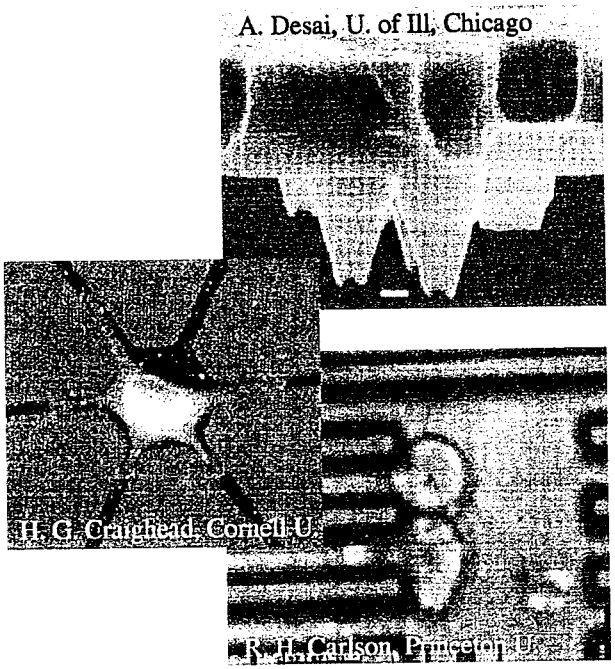
Biological pathway elucidation & target validation

Small molecule/protein interactions

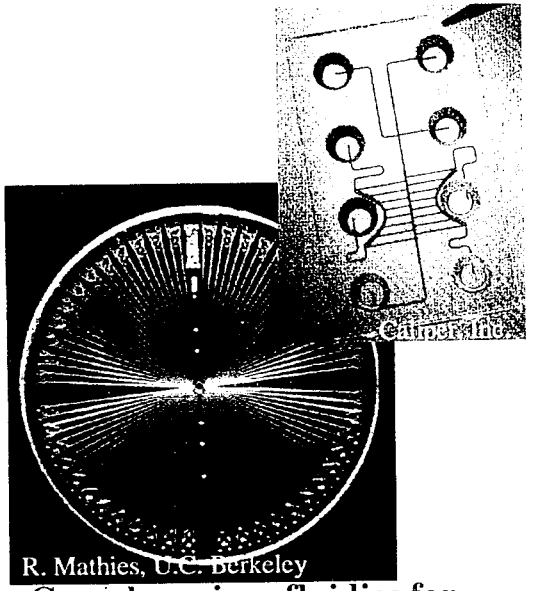
Ligand fishing & drug discovery

Intervention delivery

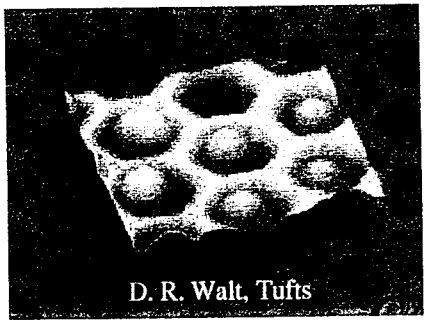
NCI



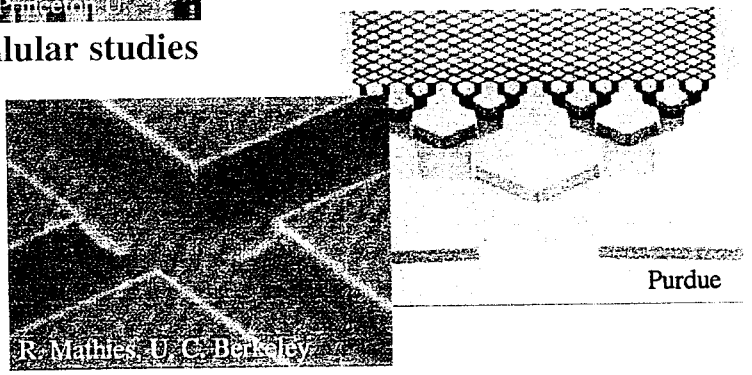
Biocapsules and cellular studies



Complex micro fluidics for integrated functionality



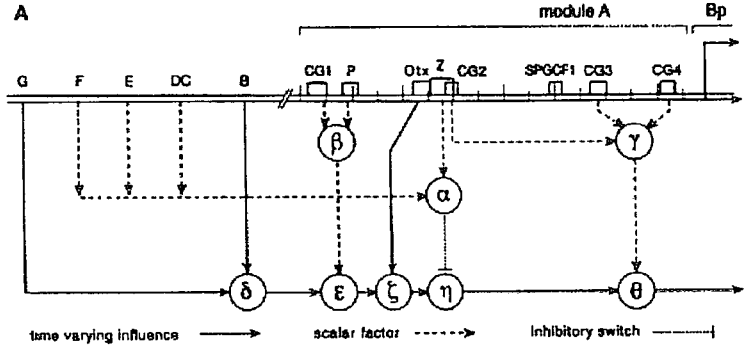
Innovative new sensor concepts



Precision microfabrication

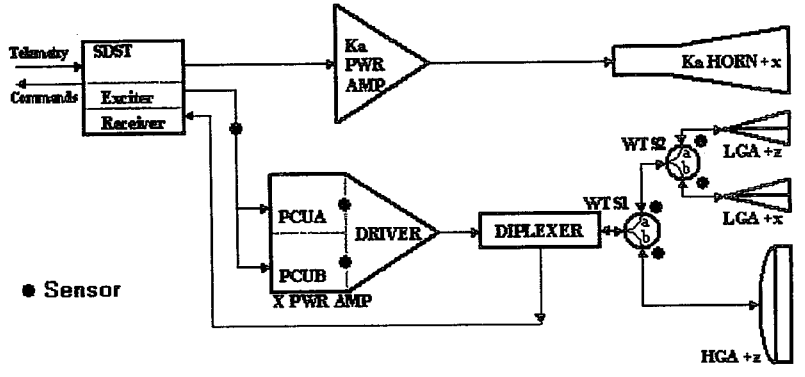
Bio - Informatics

Gene Regulation Computational Models

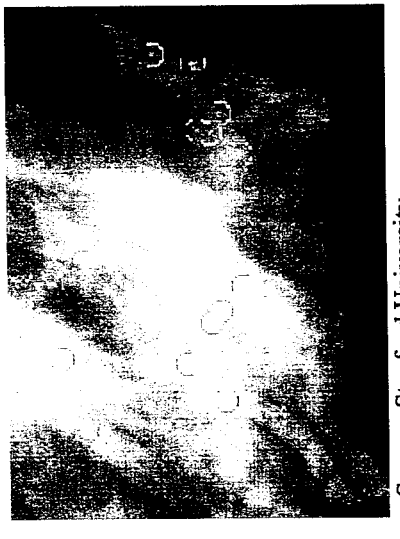


Source: Science, Volume 279, Number 5358 Issue of 20 Mar 1998, pp. 1896 - 1902

Model-Based Reasoning For Autonomous Spacecraft

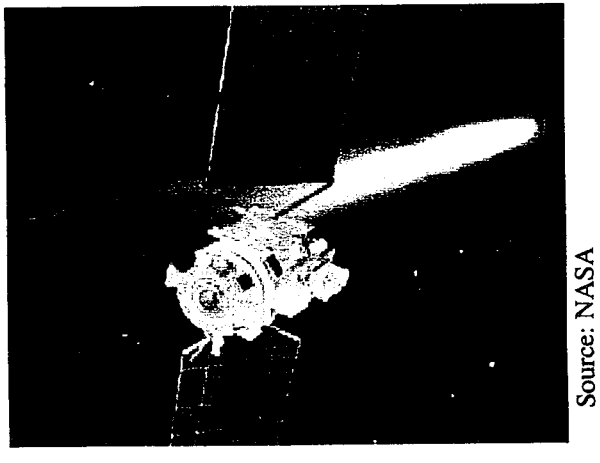


High Resolution Imaging: Data Intensive Computing and Visualization



Source: Stanford University

Source: NASA



Source: NASA

Bio-Informatics Computing Intersections

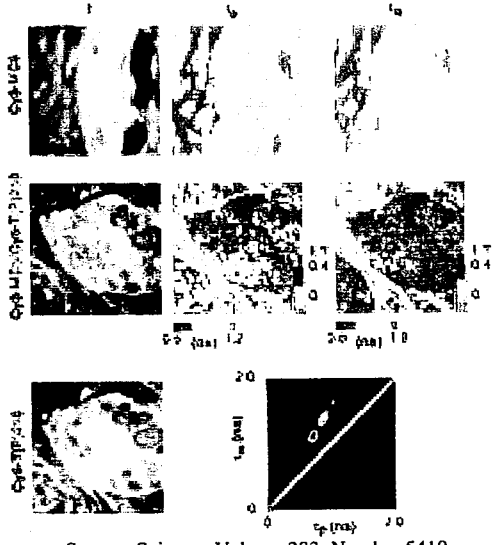
NASA	Computing	NCI
Earth Observation Planetary Probes	Imaging	Cell Analysis for discovery Diagnostic Imaging
Simulation Earth Sciences	Visualization	3D Image presentation Molecular Analysis Data Sets
Earth Sciences Astrophysics	Image Interpretation	Gene Expression Molecular Imaging
Earth Observation On-board Science Robotics	Machine Learning & Discovery	Molecular Analysis Data Sets Bioinformatics Diagnostic Image Analysis
Autonomy Self-Analysis	Model-Based Reasoning	Gene regulation models Smart Sensors
Intelligent Design Earth Sciences	Shared Computing Models	Clinical Investigation Bioinformatics
Intelligent Design Simulation	Evolutionary Computing	Drug Discovery Bioinformatics
Autonomy Operations	Validation & Verification	Molecular Pathway Models Cinical Data Analysis
Knowledge Discovery	Data Integration & interpretation	Synthesis of mixed data sets Integration of discovery preclinical and clinical data

Data Synthesis and Visualization

Image Analysis

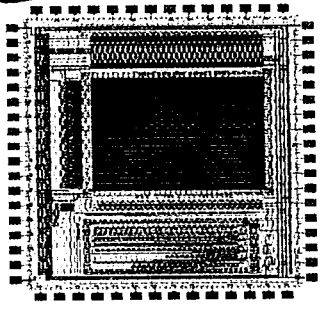
Sir-C Image of Western Pacific Rain Storm

Cell Imaging

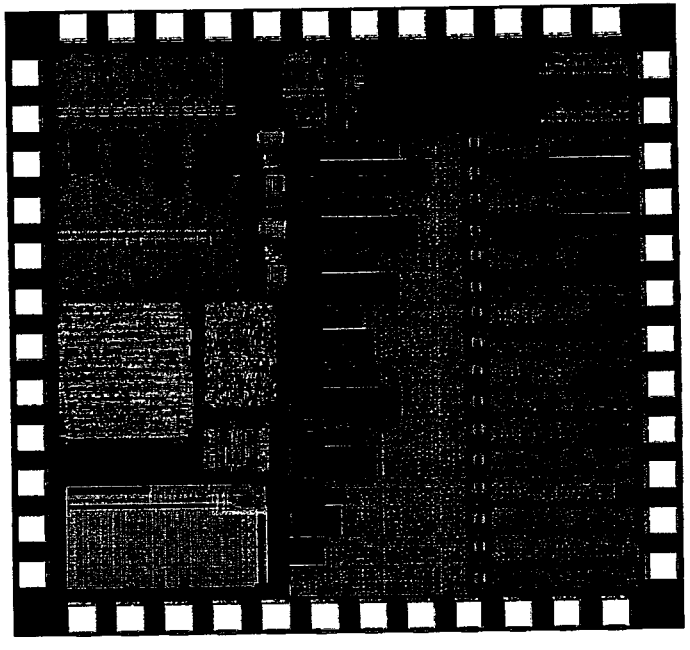


Source: Science, Volume 283, Number 5410
Issue of 26 Mar 1999, pp. 2085 - 2089

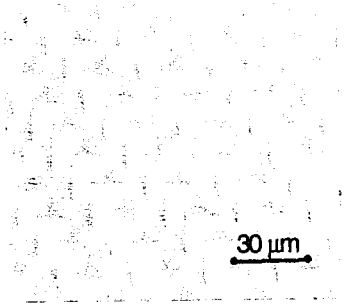
End to End System Integration



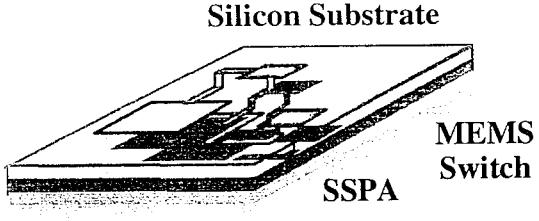
Integrated Sensors



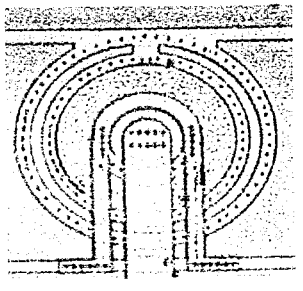
Design, Integration, Fabrication and Test



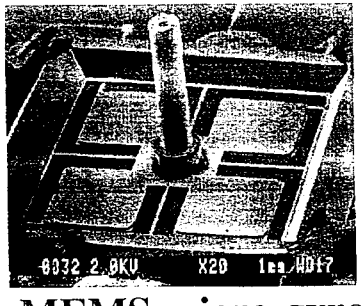
On-Chip Power Source



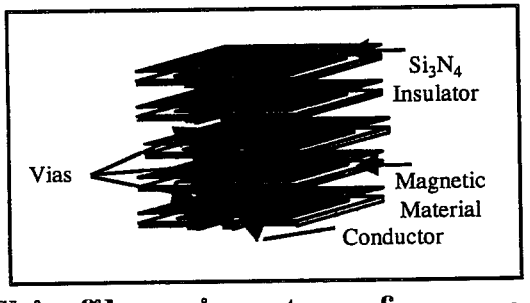
Advanced Micro-machined Communications System



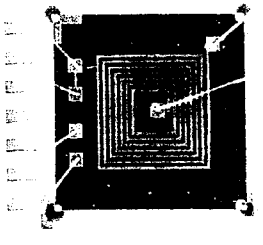
Power Management & Distribution



MEMS micro-gyro

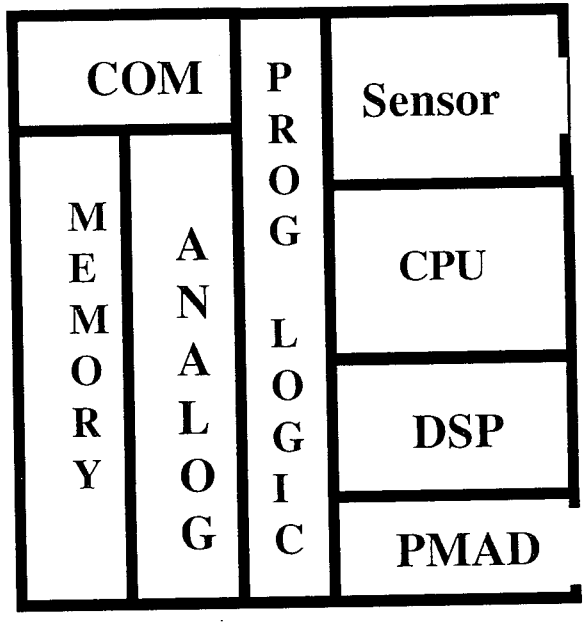


Thin film micro-transformers

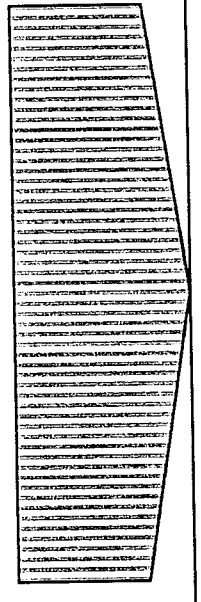


Embedded passive components

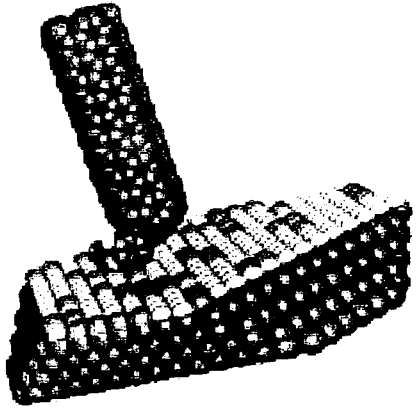
Sample Pilot Project 1:
Integrated Bio-Molecular Sensor



micro-electronic System on a Chip

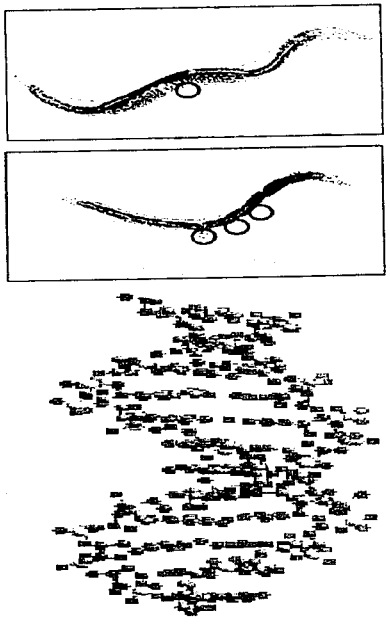


Sensor Interface



Nano-Sensor based on confluence of Biology, Chemistry, Physics and Computer Science

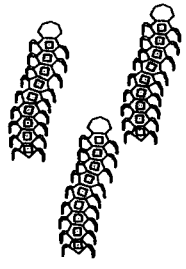
Medical Applications



NASA Application

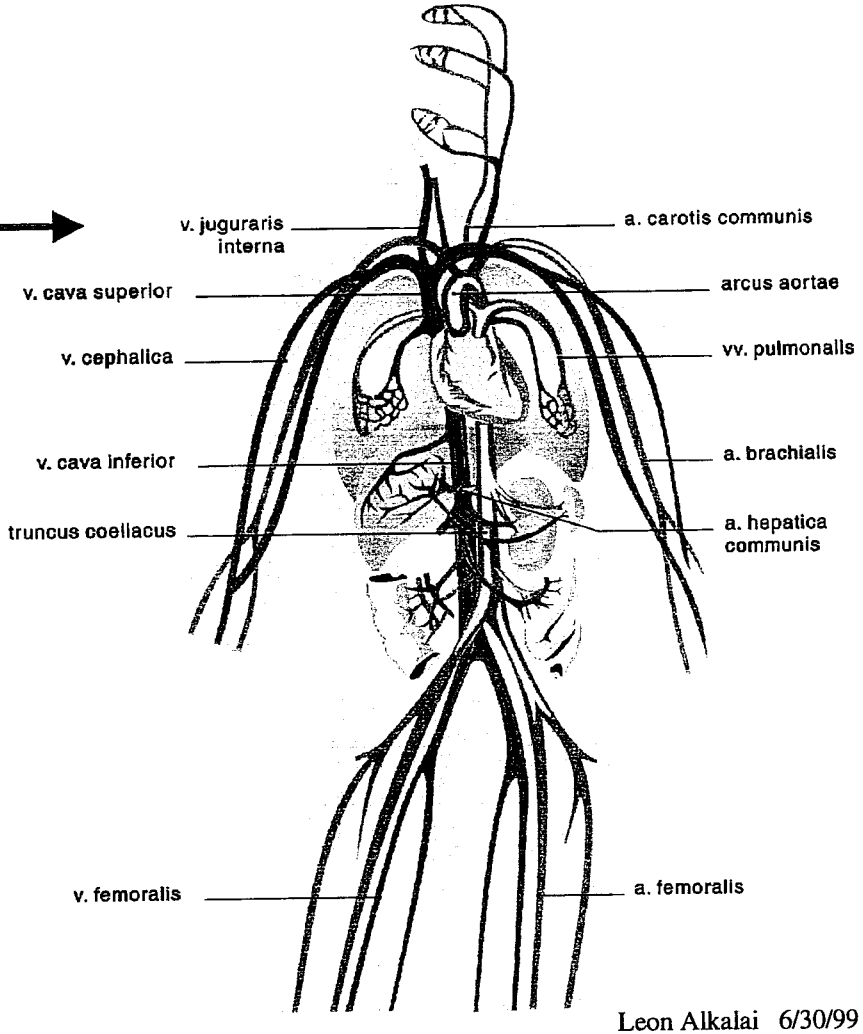
Sample Pilot Project 2:
Mission to the Human Body

Micro-explorers



Implantation
Injection

Human Cardiovascular System



NASA

Distributed In-Situ Science (Mars, etc.)

Integrated Vehicle Health Management

Astronaut Capability & Health Monitoring

NCI

Distributed detection of early pre-cancer cells

Detection of cancer recurrence

Accurate staging of cancer

Intervention monitoring

Sample Pilot Project 3:
Information Synthesis and Visualization

NASA

Distributed In-Situ Science (Mars, etc.)

Integrated Vehicle Health Management

Astronaut screening

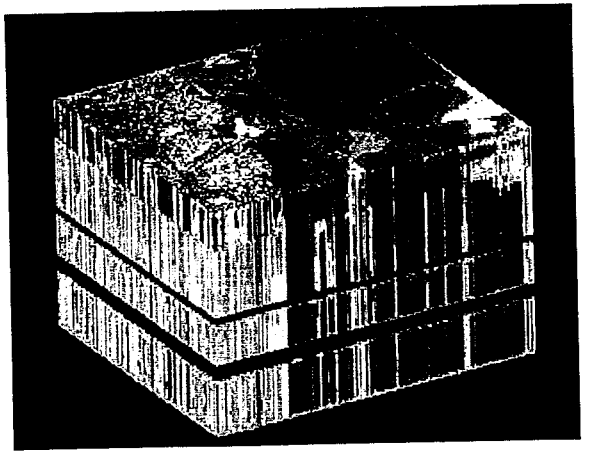
Tools for very large dimension data sets

Tools for comprehensive molecular analysis

Patient specific clinical applications

NCI

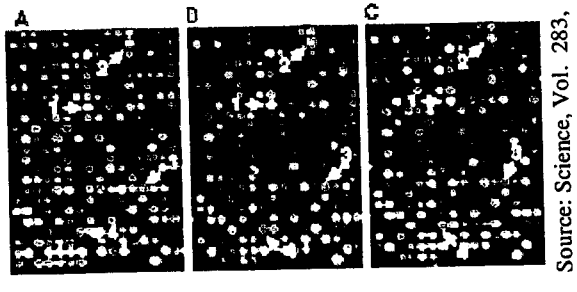
Airborne Visible InfraRed Imaging Spectrometer



Source: NASA

Ultra dimensional data

Gene Expression



Source: Science, Vol. 283, No. 5398, 1 Jan 1999, pp. 83 - 87

Comprehensive Molecular Analysis

Infrastructure for Bio-Molecular Engineering

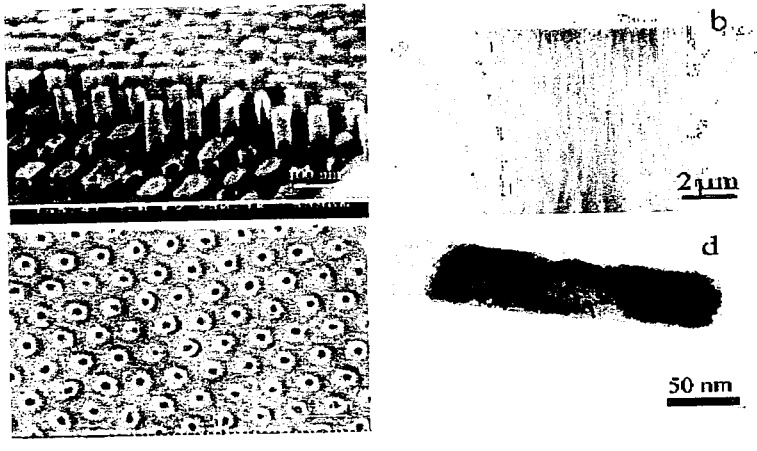
- Carbon Nano Tube Sensors and Devices
  - Nano mechanical structures and devices (Ref. Prof. Charles Lieber, Harvard)
  - Non-lithographic methods of fabrication (Ref. Prof. J. M. Xu, University of Toronto).

- Molecular Systems Engineering
  - *"Biology is the best system architect at the molecular level"*, M. Heller, CTO, Nanogen

- Biomimetic Materials and Systems
  - Molecular self assembly and self organization

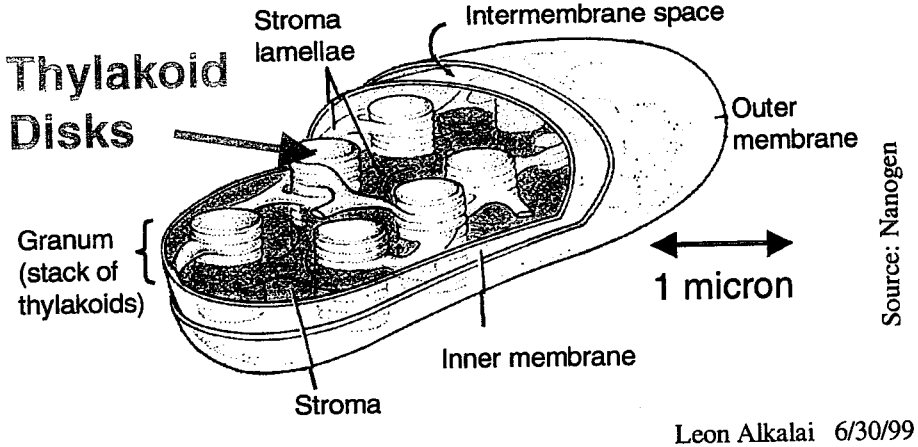
- Infrastructure
  - Needs to integrate nano device fabrication processes at the quantum level and molecular engineering at the system level.

Non-Lithographic fabrication of CNT

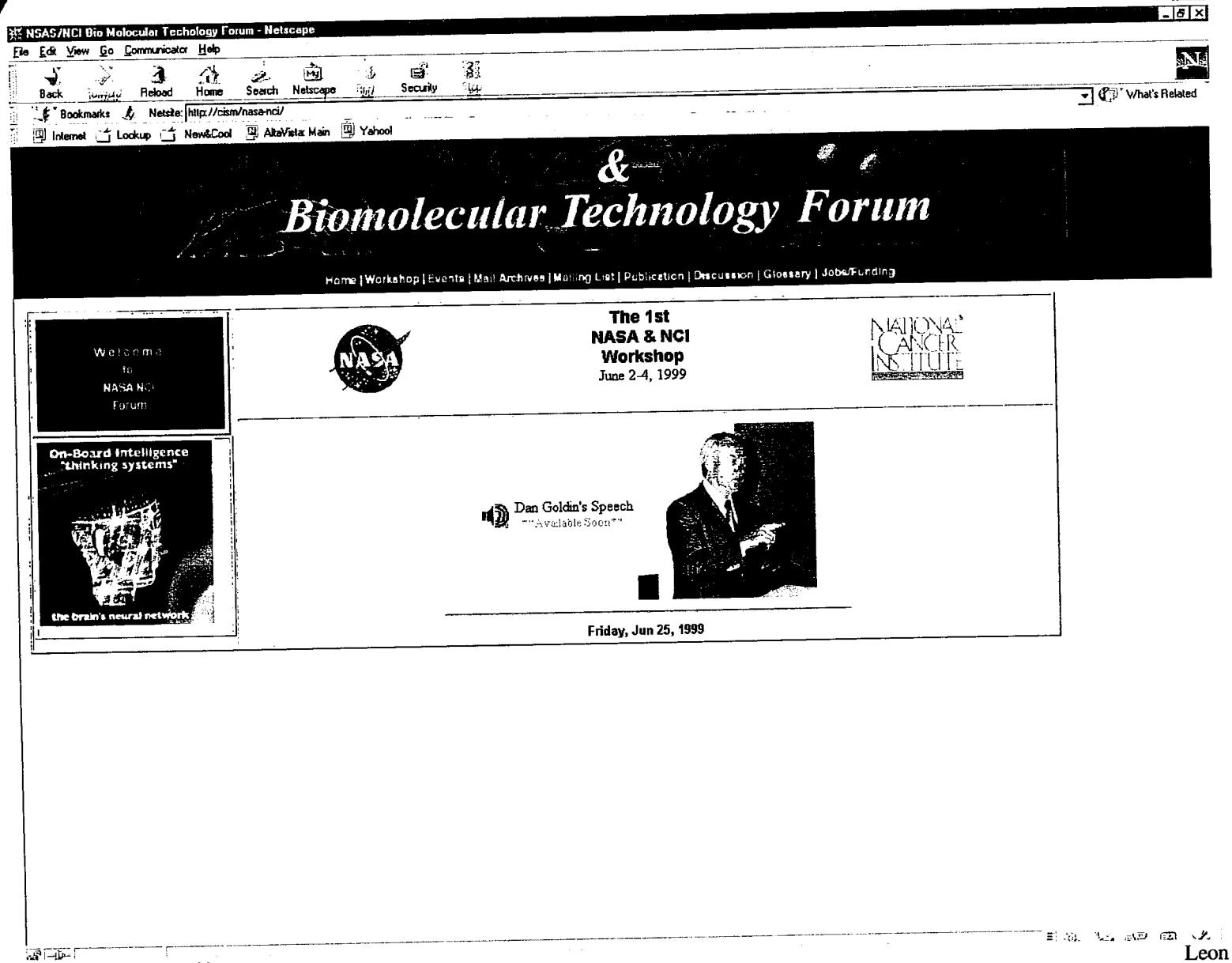


Source: Prof. Xu, Univ. Of Toronto

Plant Chloroplast



Source: Nanogen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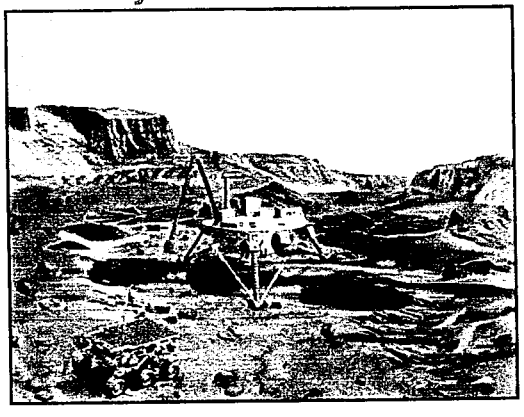
Bookmarks Netsite: http://cism/nasa-nci/
Internet Lookup New&Cool AltaVista Main Yahoo!
What's Related
&
Biomolecular Technology Forum
Home | Workshop | Events | Mail Archives | Mailing List | Publication | Discussion | Glossary | Jobs/Funding
Welcome to NASA NCI Forum
On-Board Intelligence "thinking systems"
the brain's neural network
The 1st
NASA & NCI
Workshop
June 2-4, 1999
Dan Goldin's Speech
"Available Soon"
Friday, Jun 25, 1999

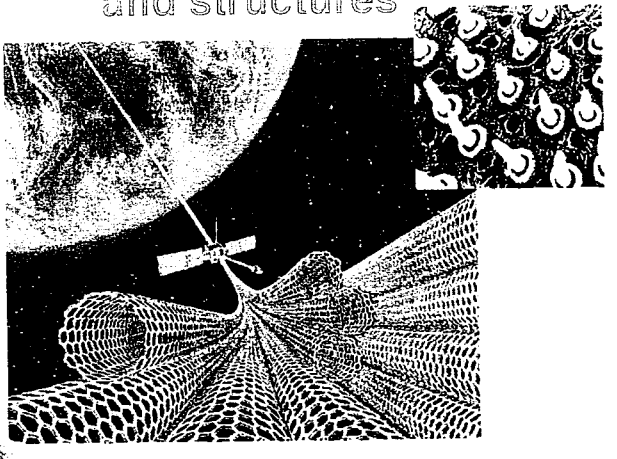
Bio Technology Benefits to NASA

NATIONAL CANCER INSTITUTE

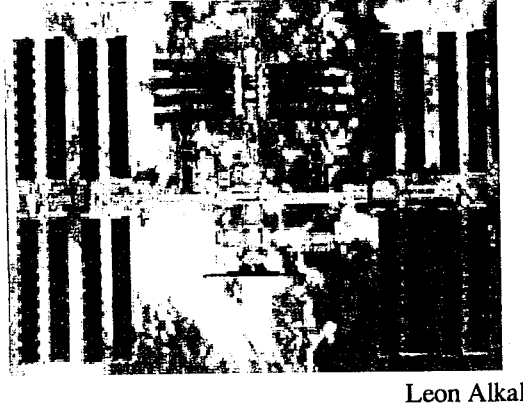
Miniaturized biochemical analytic laboratories



Fabrication of ultra rugged materials and structures



Bio-Astronautics and Human Exploration



Biomimetic systems for Earth and Deep Space Robotic exploration